

**Claims:**

1. An interferometric sensor comprising:  
a mandrel having a first portion with a first diameter and a second portion with a second diameter;  
two Bragg gratings formed in an optical waveguide; and  
a section of optical waveguide between said Bragg gratings, wherein said section of optical waveguide is wound on said mandrel such that a length of the optical waveguide section is determined by a number of turns wrapped around each of the first and second portions.
2. The interferometric sensor of claim 1, wherein said first portion and said second portion are connected by a slot to guide a portion of the optical waveguide section.
3. The interferometric sensor of claim 1, wherein said mandrel comprises a material selected from a group consisting of Nylon, Teflon, and Peek.
4. The interferometric sensor of claim 1, wherein said mandrel includes a center bore.
5. The interferometric sensor of claim 4, wherein at least one Bragg grating is located in said center bore.
6. The interferometric sensor of claim 1, wherein said mandrel includes at least two bores.
7. The interferometric sensor of claim 6, wherein at least one Bragg grating is located in a bore.

8. The interferometric sensor of claim 1, wherein said mandrel includes a third portion having said second diameter.
9. The interferometric sensor of claim 8, wherein said first portion is between said second and third portions.
10. The interferometric sensor of claim 7, wherein said mandrel includes a third portion having a third diameter.
11. The interferometric sensor of claim 1, wherein the Bragg gratings are isolated from strain.
12. The interferometric sensor of claim 1, wherein a distance of optical waveguide between the Bragg gratings defines an interferometric path length.
13. An acoustic sensing system comprising:
  - a source for generating light pulses;
  - an acoustic sensor having two Bragg gratings separated by an optical waveguide section wrapped around a mandrel with a first portion with a first diameter and a second portion with a second diameter, wherein a length of the optical waveguide section is determined by a number of turns wrapped around each of the first and second portions; and
  - signal processing equipment for detecting variations in phase between light pulses reflected from the two Bragg gratings caused by changes in length of the optical waveguide section due to acoustic energy impinging on the mandrel.
14. The acoustic sensing system of claim 13, wherein said first portion and said second portion are connected by a slot to guide the optical waveguide section from the first portion to the second portion.

15. The acoustic sensing system of claim 13, wherein at least one Bragg grating is positioned within a center bore of the mandrel.
16. The acoustic sensing system of claim 13, wherein:  
the mandrel includes at least two bores; and  
each of the Bragg gratings is positioned within one of the at least two bores.
17. The acoustic sensing system of claim 13, wherein said mandrel includes a third portion having said second diameter.
18. The acoustic sensing system of claim 17, wherein said first portion is between said second and third portions.
19. The acoustic sensing system of claim 13, wherein said mandrel includes a third portion having a third diameter.
20. The acoustic sensing system of claim 13, wherein the Bragg gratings are isolated from strain.
21. The acoustic sensing system of claim 13, wherein a distance of optical waveguide between the Bragg gratings defines an interferometric path length.
22. A method of controlling a length of an optical waveguide section during manufacture of an interferometric sensor, comprising:  
providing a mandrel having at least a first section with a first outer diameter and a second section with a second outer diameter;  
wrapping the optical waveguide section a first number of times around the first section and a second number of times around the second section; and  
controlling the wrapped length of the optical waveguide section by varying the first number and the second number.

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23. The method of claim 22, further comprising forming two Bragg gratings that bound the optical waveguide section so as to define an interferometer path length.

24. The method of claim 22, further including the step of isolating the Bragg gratings from strain.